

REMARKS

Reconsideration and allowance of the present application based on the above amendments and following remarks are respectfully requested. New claims 27 to 75 have been added. Claims 1-8 and 10-12 have been amended without the intention of narrowing the scope of any of the claims.

Claims 1-12 were rejected under 35 U.S.C. § 102(e) over Loopstra (U.S. Patent No. 6,208,407). Applicants respectfully traverse this rejection.

Loopstra merely discloses a lithographic projection apparatus that comprises a height sensor to measure local height of a substrate at a number of points on the substrate and a second, other height sensor to measure the height of a reference plane of the substrate holder. Accordingly, Loopstra fails to disclose “a height mapping system ... comprising at least one sensor ... both to measure positions of a plurality of points on a surface of said substrate... and to measure a position of said physical reference surface” as claimed in claim 1.

The process disclosed by Loopstra involves independent measurement of the reference plane 170 and measurement of the height of the substrate, making it necessary to accurately know the measurement relationship between the two measurement devices disclosed in Loopstra. An advantage of the claimed invention is, for example, measurement of the position of the surface of the substrate and the position of the physical reference surface by the same sensor therefore eliminating the need to know the relationship between the two devices disclosed in Loopstra.

Therefore, Applicants respectfully submit that claim 1 is patentable over Loopstra. Claims 2-12 depend from claim 1, and are, therefore, also patentable over Loopstra. Applicants, therefore, respectfully request that the rejection of claims 1-12 under 35 U.S.C. § 102(e) be withdrawn.

Claims 1-12 were rejected under 35 U.S.C. § 103(a) over Loopstra et al. PCT publication (PCT Publication No. WO 99/28790) in view of Loopstra et al. U.S. patent (U.S. Patent No. 5,969,441). Applicant respectfully traverses this rejection.

The Loopstra et al. PCT Publication merely discloses a lithographic projection apparatus that comprises a height sensor to measure local height of a substrate at a number of points on the substrate and an interferometer to measure the height of the substrate. The Loopstra et al. PCT Publication fails to at least disclose or suggest the “a height mapping

system located at said measurement station comprising at least one sensor constructed and arranged both to measure positions of a plurality of points on a surface of said substrate in a first direction substantially perpendicular to said surface and to measure a position of said physical reference surface in said first direction, said lithographic apparatus constructed and arranged to create a height map, relative to said physical reference surface, from said positions of the plurality of points on the surface of the substrate" as claimed in claim 1. More specifically, for example, the Loopstra et al. PCT Publication fails to provide any disclosure or suggestion regarding a "lithographic apparatus constructed and arranged to create a height map". Applicants further submit that the Loopstra et al. U.S. Patent fails to overcome these deficiencies of the Loopstra et al. PCT Publication as Examiner notes the Loopstra et al. U.S. Patent merely discloses a positioning system to move a table between a measurement station and an exposure station.

Claim 1, thus, is patentable over the Loopstra et al. PCT publication in view of the Loopstra et al. U.S. patent. Claims 2-12 depend from claim 1, and are, therefore, also patentable over the Loopstra et al. PCT publication in view of the Loopstra et al. U.S. patent. Applicants, therefore, respectfully request that the rejection of claims 1-12 under 35 U.S.C. § 103(a) be withdrawn.

CONCLUSION

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

Attached is a marked-up version of the changes made to the claims by the current amendment. The attached Appendix is captioned "Version with markings to show changes made".

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

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Enclosure: Appendix

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims are amended as follows:

1. (Thrice Amended) A lithographic projection apparatus comprising:

~~a radiation system for supplying a projection beam of radiation;~~
~~a first object table provided with a mask holder constructed and arranged tofor holding a mask;~~

~~a second, movable object table provided with a substrate holder constructed and arranged tofor holding a substrate and having a physical reference surface fixed thereonte;~~

~~a projection system constructed and arranged tofor -imaging an irradiated portion of the mask onto a target portion of the substrate;~~

~~a positioning system constructed and arranged tofor -moveing said second object table between an exposure station, at which said projection system can image said mask portion onto said substrate, and a measurement station;~~

~~a height mapping system located at said measurement station comprising at least one sensor and -constructed and arranged both to measure positions heights, relative to said physical reference surface, -of a plurality of points on a surface of said substrate in a first direction substantially perpendicular to said surface held on said substrate holder and to measure a position of said physical reference surface second object table in said first direction substantially perpendicular to said surface of the substrate, said lithographic apparatus constructed and arranged and to create a height map, relative to said physical reference surface, from said positions of the plurality of points on the surface of the substrate thereof;~~

~~a position measuring system located at said exposure station constructed and arranged tofor -measureing a position of said physical reference surface in said first direction substantially perpendicular to said substrate surface, after movement of said second object table to said exposure station; and~~

~~a position controller constructed and arranged to control at the position of said second object table in at least said first direction, during exposure of said target portion, in~~

accordance with said height map and said position measured by said position measuring system.

2. (Twice Amended) Apparatus according to claim 1, wherein said controller is further arranged to control at the tilt of said second object table about at least one axis perpendicular to said first direction in accordance with said height map.

3. (Twice Amended) Apparatus according to claim 1, wherein said sensorheight mapping system comprises a level sensor constructed and arranged to simultaneously measure positions in said first direction of a linear array of points.

4. (Twice Amended) Apparatus according to claim 1, wherein said sensorheight mapping system comprises a level sensor constructed and arranged to measure a position of a measurement beam reflected by at least one of said surface and said physical reference surface the surface whose position in said first direction is to be measured.

5. (Twice Amended) Apparatus according to claim 4, wherein said level sensor comprises:

a projection grating;

projection optics constructed and arranged to for -projecting an image of said projection grating onto said at least one of said surface and said physical reference the surface whose position in said first direction is to be measured;

a detection grating;

detection optics constructed and arranged to for focusing light reflected by said at least one of said surface and said physical reference surface to form on said detection grating an image of said projection grating; and

a detector constructed and arranged to for detecting Moiré patterns formed by an overlay of said image of said projection grating on said detection grating.

6. (Twice Amended) Apparatus according to claim 5, wherein said level sensor further comprises a radiation source or illuminator constructed and arranged to illuminate said projection grating with polychromatic radiation and wherein said projection optics and said detection optics comprise reflective optical elements.

7. (Twice Amended) Apparatus according to claim 1, wherein said height mapping system comprises a first sensor~~level sensor~~ constructed and arranged to for detecting at least one of the positions in said first direction of the surface of said substrate at said plurality of points of said plurality of points on the surface of said substrate and the position of said physical reference surface and a second sensor~~position detector~~ constructed and arranged to for -detecting at the position in said first direction of said second object table substantially simultaneously with measurements by said first sensor~~level sensor~~.

8. (Twice Amended) Apparatus according to claim 7, wherein said second sensor~~position detector~~ comprises an interferometer.

10. (Twice Amended) Apparatus according to claim 1, wherein said position measuring system is constructed and arranged to measure the position of said physical reference surface relative to the focal plane of said projection system.

11. (Twice Amended) Apparatus according to claim 1, wherein:
said second object table has a plurality of spaced-apart physical reference surfaces;
and

said lithographic apparatus is constructed and arranged to create the height map
relative to a reference plane defined by said plurality of physical reference surfaces~~said height~~
~~mapping system is constructed and arranged to measure heights of said plurality of points~~
~~relative to a reference plane defined by said plurality of physical reference surfaces.~~

12. (Twice Amended) Apparatus according to claim 1, further comprising:
a second-height mapping system located at said exposure station constructed and arranged to measure positions~~heights, relative to said physical reference surface, of a~~ said plurality of points on at the surface of a substrate in a direction substantially perpendicular to said surface~~held on said substrate holder, said lithographic apparatus constructed and~~
~~arranged and to create a height map, thereof relative to said physical reference surface, from~~
~~said positions of the plurality of points on the surface of the substrate;~~ and

a height calibrator constructed and arranged to compare height maps of said a single substrate prepared by each of said first and second-height mapping systems to derive a

relative calibration for separate position detection systems provided at said measurement and exposure stations.

End of Appendix